

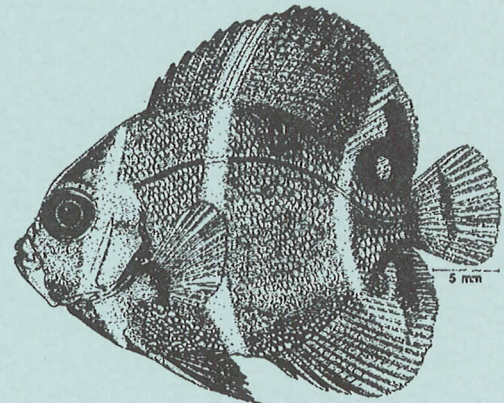
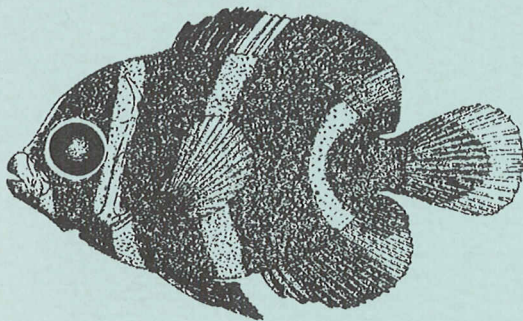
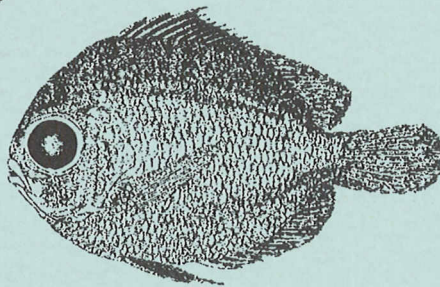
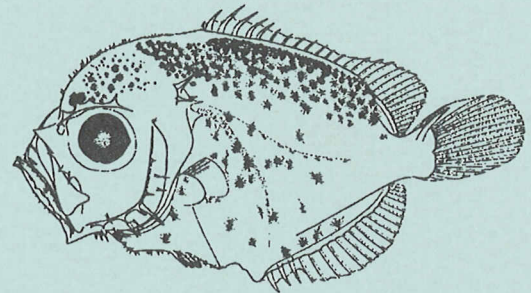
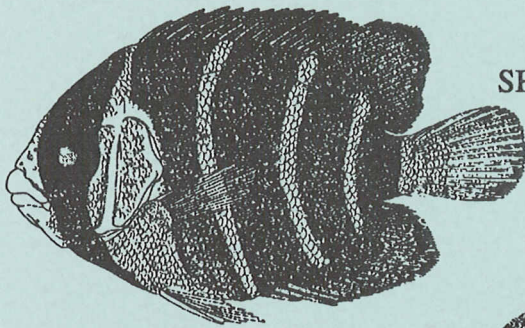


NOAA Technical Memorandum NMFS-SEFSC-375

PRELIMINARY GUIDE TO THE IDENTIFICATION OF THE EARLY LIFE HISTORY STAGES OF POMACANTHID FISHES OF THE WESTERN CENTRAL ATLANTIC AND GULF OF MEXICO

by

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U. S. DEPARTMENT OF COMMERCE
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INTRODUCTION

This guide is intended for the identification of early life history specimens of angelfish (Pomacanthidae) collected principally by plankton nets from marine waters of the western central Atlantic. Defined by FAO, the western central Atlantic Fishing area 31 includes the Gulf of Mexico and Caribbean Sea. This area is bounded by 35° north latitude on the north, 50° west longitude on the east, the Equator on the south, and the continental margins on the west. The region is tropical and subtropical with important fishing areas and a high diversity of species. The area is also characterized by large amounts of coral reefs.

This paper is part of a larger effort, which is underway to develop a manual for the identification of the early life history stages of all fishes in this area.

The family Pomacanthidae contains three genera in the western central Atlantic; Pomacanthus, Holacanthus and Centropyge. The adults and juveniles of all Atlantic species are brightly colored and considerably well documented by Fraser-Brunner (1933), Böhlke and Chaplin (1968), Feddern (1968), Randal (1968), Burgess (1974), Allen (1979), Robins et al. (1986). Breeding and rearing of four species; P. paru, P. arcuatus, H. tricolor, C. argi, by Moe (1976, 1977), and C. argi by Bauer and Bauer (1981), Holt (pers. comm.) has been attempted. Unfortunately, except for the gray angel (Pomacanthus arcuatus), larvae were only successfully reared to a maximum of seven days and except for a few photographs (Moe, 1977) are undescribed.

In this study reared Pomacanthus arcuatus described by Kelley (1995), and laboratory reared larvae of H. tricolor and C. argi (Moe 1976, 1977) and wild-caught specimens of all three genera are used. Cleared and stained adult and large juveniles of all genera and species were used for purposes of insuring correct identifying counts, as well as counts given by Feddern (1968, 1972), Randall (1968), and Miller and Jorgenson (1973). The rarest counts are given in parentheses. The meristic tables were modified after Matsui (1967).

My counts on the second dorsal and anal fin rays were one over that of Feddern (1972). This may be due to my use of cleared and stained specimens which showed clearly the last pterygiophore with two rays associated with it, of which both were counted. The last two rays are routinely counted as one which probably accounts for the difference.

Useful characters to sperate the three genera are given in Table 1.

GENUS Centropyge

The genus Centropyge has two species C. argi and C. aurantonotus.

I was unable to determine a difference between the two Centropyge species in the larval stage. It is unknown if this was due to a lack of C. aurantonotus larvae or to appearance similarities. The pigmentation of larval Centropyge is very similar to pigmentation of Holacanthus making it very difficult to sperate larvae. Reared and wild-caught larval Centropyge (1.8 - 2.0 mm NL) had one to six scattered melanophores on anterior and dorsal edge of the premaxilla, one to two melanophores on the lower jaw, one to five melanophores on forebrain, one to three melanophores on the midbrain and up to five melanophores on the hindbrain. Just posterior of the nape, along the dorsal lateral edge of the body is a line of single melanophores starting at the third or fourth myomere and proceeding to the 15th myomere. Parallel to this pigment, along the lateral line starting at the eighth and ending at the 15th myomere, is a line of single melanophores. The dorsal edge of the gut is covered internally with dense pigment. Starting at the anus, and proceeding to the 15th myomere on the ventral lateral edge, is a row of single melanophores. The dorsal and anal fin folds have pigmentation above and below the 14-15th myomere. This finfold pigment differentiates Centropyge and Holacanthus tricolor larvae which has no pigment on either the dorsal or anal fin. Pigmentation becomes denser on the midbrain continuing posteriorly to just anterior of the caudal peduncle and pigment on the dorsal edge of body proceeds ventrad with denser pigmentation along the dorsal edge. Meristic counts provide generic differentiation by using a combination of low second dorsal fin counts (16-18) and very high gill raker counts (21-24). Besides pigmentation, a distinct character of Centropyge is an elongated third dorsal spine. This spine begins to elongate at 3.4 mm SL and is considerably elongated by 4.3 mm SL, thus making identification easy. Holacanthus and Pomacanthus larvae do not have this elongated 3rd dorsal spine. Flexion begins in Centropyge at 3.3 mm and is completed by 3.8 mm SL.

Common arrangement of predorsal bones, pterygiophores, fin spines and rays in relation to the skull and vertebral column for nine *C. argi*, one *C. aurantonotus*, Modified after Matsui (1967). A, skull and vertebrae numbers; B, interneural and interhaemal space numbers; C, number of pterygiophores in the respective interneural or interhaemal space; D, number of fin spines or rays associated with the pterygiophore; E, frequency of occurrence in 9 specimens for the pterygiophore number in the respective interneural or interhaemal spaces.

C. argi:

PREDORSAL BONES		FIRST DORSAL FIN												SECOND DORSAL FIN											
9	9	9	9	9	9	9	9	9	9	9	9	9	9	8	9	8	8	6	6	E					
0	0	3	2	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	4	D				
1	0	1	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	C				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	B					
8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A
												11	12	13	14	15	16	17	18	19	20	B			
												1	1	2	2	2	2	2	2	3	1	C			
												3	1	2	2	2	2	2	2	3	2	D			
												9	9	9	9	9	9	9	8	7	7	E			
												ANAL FIN													

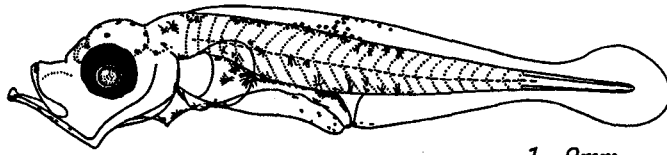
C. aurantonotus

PREDORSAL BONES		FIRST DORSAL FIN												SECOND DORSAL FIN																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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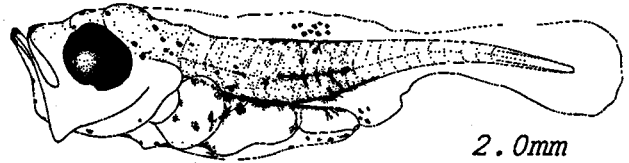
POMACANTHIDAE	<u>Centropyge argi</u>
Meristic Characters	Early Life History Description
VERTEBRAE	EGGS
Precaudal: 10	Diameter: 0.60-0.65 mm buoyant, transparent, spherical and refractile, with narrow perivitelline
Caudal: 14	No./Size of oil Globules: one, 0.1-0.15 mm in diameter
Total: 24	Yolk: Homogenous
First Dorsal Fin: XIV-(XV)	Hatch Size: 1.4 mm NL
Second Dorsal Fin: 17-(18)	Incubation: 30-32 hrs. after fertilization
Anal Fin: III, 18(16-17)	Pigment: Dense concentration of pigment spots along dorsal notochord area
Pectoral Fin: I, 15-16	Diagnostic Characters: Size, pigmentation
Gill Rakers: 21-24	LARVAE
Predorsal bone formulae: 0//2/1+1	Head Spination: Na, La, Po, So 1 & 2, St, It, PT, SCl, AJ,
LIFE HISTORY	Length at Flexion: 2.4-3.5 mm SL
Range: Bermuda, West Indies, Caribbean, common in N.W. & S. Gulf of Mexico, rare E. Gulf of Mexico.	Sequence of Fin Development:
Habitat: Coral reefs in depths 5-100 meters	Pigmentation: lower & upper jaws, dorsal edge premaxillary, midbrain, hindbrain, along dorsal edge until 14-15th myomere, Fin pigment D & A at 15th myomere, lat. line pigment midbody 7th-18th myomere. (Internal) dorsal edge gut, (external) scattering on gut.
ELH Pattern: Omnivorous; pelagic eggs & larvae; juveniles; shallow and deep coral reefs & debris	Diagnostic Characters: third spine in first dorsal fin is elongated. Second dorsal counts lower than other species.
SPAWNING	EARLY JUVENILES
Season: Continuous, No season	Settlement Size:
Area: Coral reefs, 1m, above in water column	Pigment: same as larvae, heavier pigment on dorsal body edge spreading anterior & ventrad
Mode: Harems, one male & three to four females	Diagnostic Characters: elongated 3rd D spine, scale spination, Combination low D2 & high GR count
Migration: None, territorial	LITERATURE: Allen, G.R., 1980; Bauer & Klaij, 1974; Bauer, 1975; Bauer and Bauer, 1981; Dennis, G.D. (thesis) 1985; Feddern, H.A. 1972; Moe, M. 1976, 1977.
Fecundity: 119 eggs/day	
SIZE/AGE	
Maturity: 5cm FL	
Longevity: 8+ years	

POMACANTHIDAE

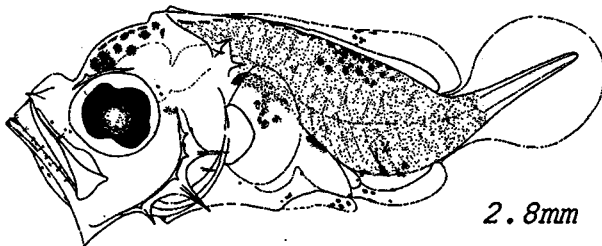
Centropyge argi



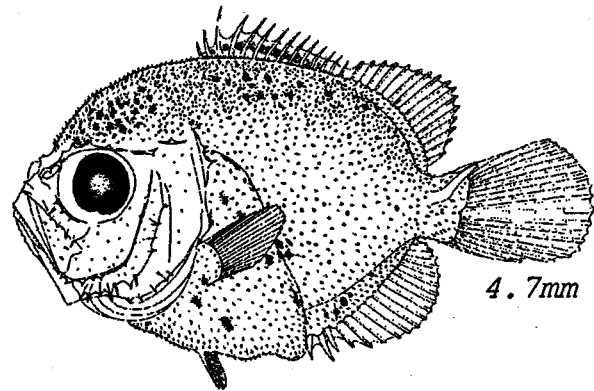
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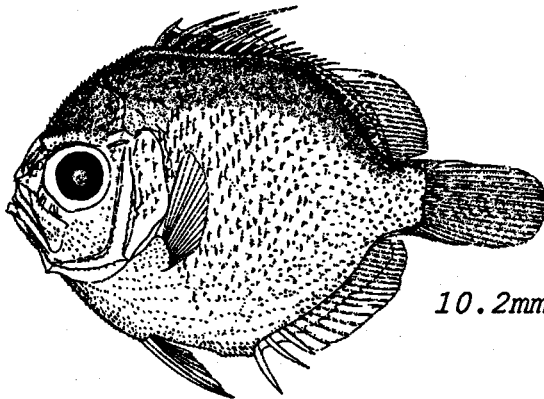
2.0mm



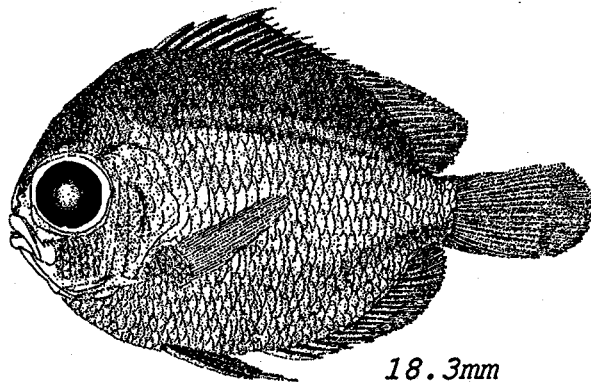
2.8mm



4.7mm



10.2mm



18.3mm

POMACANTHIDAE**Centropyge aurantonotus**

Meristic Characters**VERTEBRAE**

Precaudal: 10

Caudal: 14

Total: 24

First Dorsal Fin: XIV

Second Dorsal Fin: 16

Anal Fin: III, 18

Pectoral Fin: I, 15

Gill Rakers: 21

Predorsal bone formulae: 0/2/1+1

LIFE HISTORY

Range: Territory 1.5 x 4m

Habitat: Isolated patches of staghorn coral. 16-200 meters

ELH Pattern: Omnivorous; pelagic eggs & larvae; territorial juveniles, adults

SPAWNING

Season: Continuous throughout year without seasonal or lunar periodicity.

Area: Above coral reefs in water column

Mode: Harems, two-four females and one male

Migration: No migration, territorial

Fecundity: 119 eggs/fish/day

SIZE/AGE

Maturity: 5cm TL

Longevity: 10 years

Early Life History Description**EGGS**

Diameter: 0.60-0.65mm

No. of oil Globules: single, 0.10-0.16mm diameter

Yolk: Homogenous

Hatch Size: 1.4mm

Incubation: 15 -20 hrs.

Pigment:

Diagnostic Characters:

LARVAE: UNKNOWN

Head Spination:

Length at Flexion:

Sequence of Fin Development:

Pigmentation:

Diagnostic Characters:

EARLY JUVENILES UNKNOWN

Settlement Size: 20mm SL

Pigment:

Diagnostic Characters:

LITERATURE: G. R. Allen (1980), Bauer and Bauer (1981), Robins et. al 1986.

POMACANTHIDAE *Centropyge aurantonotus*

GENUS Holacanthus

The genus Holacanthus has three species - H. ciliaris; the queen angel, H. bermudensis; the blue angel and H. tricolor; the rockbeauty. Due to the close meristic and morphological features of H. ciliaris and H. bermudensis larval identification is very difficult. The main difference between H. ciliaris and H. bermudensis is in pigmentation on the gular membrane which H. ciliaris has and H. bermudensis does not; pigment development on the second dorsal fin and anal fin, both fins become totally pigmented in H. ciliaris and only at the base of the fins in H. bermudensis. Both develop similar pigmentation on the body, which starts along the dorsal and ventral edges and proceeds dorsally and ventrally to form vertical bars at 13 to 16mm SL. In juveniles the third bar is straight in H. bermudensis and curved in H. ciliaris. Meristically H. ciliaris usually had a slightly higher second dorsal and anal fin count, but two out of ten of my adult specimens of H. bermudensis had the same second dorsal and anal fin counts as H. ciliaris. The hybridization between H. ciliaris and H. bermudensis was described as a new species (Holacanthus townsendi) by Nichols & Mowbray (1914). Feddern, (1968) attempted to clarify the relationship between the intermediate, parent species.

Holacanthus tricolor had a combination of low second dorsal fin counts and low gillrakers counts thus making identification easy, also the dorsal fin of the larvae and juveniles are unpigmented. The larvae of C. argi and H. tricolor are very similar, H. tricolor lacks fin pigment and has three lines of pigment starting just posterior of the eye; one along the dorsal edge of the body, one along the lateral line, and the third along the ventral edge of the body. All three lines proceed to the 19th myomere in H. tricolor. The lateral line is pigmented and can be used as a character for identification.

Common arrangement of predorsal bones, pterygiophores, fin spines and rays in relation to the skull and vertebral column for 14 *H. bermudensis*, 18 *H. ciliaris* and 30 *H. tricolor* modified after Matsui (1967). A, skull and vertebrae numbers; B, interneural and interhaemal space numbers; C, number of pterygiophores in the respective interneural or interhaemal space; D, number of fin spines or rays associated with the pterygiophore; E, frequency of occurrence in 14 specimens for the pterygiophore number in the respective interneural or interhaemal spaces.

H. bermudensis

PREDORSAL BONES		FIRST DORSAL FIN										SECOND DORSAL FIN													
14	14	14	14	14	14	14	14	14	14	14	11	13	11	09	08	09	12	09	07	E					
0	0	3	2	1	1	1	1	1	1	1	1	1	2	2	3	3	3	3	3	D					
1	0	1	2	1	1	1	1	1	1	1	1	2	2	2	3	3	3	3	2	C					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	B					
8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A
												11	12	13	14	15	16	17	18	19	20				
												1	1	2	2	2	2	3	3	3	1				
												3	1	2	2	2	2	3	3	3	2				
												14	14	14	14	14	14	07	13	10	07				
												ANAL FIN													

H. ciliaris:

PREDORSAL BONES		FIRST DORSAL FIN												SECOND DORSAL FIN											
18	18	18	18	18	18	18	18	18	18	18	18	16	14	16	12	10	11	13	15	11	E				
0	0	3	2	1	1	1	1	1	1	1	1	2	2	2	3	2	3	3	3	3	D				
1	0	1	2	1	1	1	1	1	1	1	1	2	2	2	3	2	3	3	3	2	C				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	B					
8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A
												11	12	13	14	15	16	17	18	19	20	B			
												1	1	2	2	2	2	2	3	3	2	C			
												3	1	2	2	2	2	2	3	3	3	D			
												18	18	18	18	17	14	10	14	10	8	E			
												ANAL FIN													

H. tricolor:

PREDORSAL BONES		FIRST DORSAL FIN										SECOND DORSAL FIN													
30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	20	24	24	24	18	E					
0	0	3	2	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	3	D					
1	0	1	2	1	1	1	1	1	1	1	1	1	2	2	2	2	3	3	3	C					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	B					
8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A
												11	12	13	14	15	16	17	18	19	20				
												1	1	2	2	2	2	2	3	3	2				
												3	1	2	2	2	2	2	3	3	3				
												30	30	30	30	30	30	24	26	27	20				
												ANAL FIN													

POMACANTHIDAE

Meristic Characters

VERTEBRAE

Precaudal: 10
Caudal: 14
Total: 24
First Dorsal Fin: XIV (XIII-XV)
Second Dorsal Fin: 20 (18-21)
Anal Fin: III, 20 (18-21)
Pectoral Fin: I, 18
Gill Rakers: 3-4+10+4-6=16-22
Predorsal bone formulae:
0//2/1+1

LIFE HISTORY

Range: Bermuda, Gulf of Mexico,
southern Florida and Bahamas.

Habitat: Coral reefs in depths 1-
60 m, juveniles solitary, adults
form aggregations & pairs.

ELH Pattern: pelagic eggs &
larvae; larvae & juveniles
ectoparasite or mucophagy cleaners

SPAWNING

Season: None

Area: Coral reefs, 1-2m above coral

Mode: harems, 1 male, 2-4
females, sunset

Migration: None

Fecundity: 25 to 75 thousand eggs
per spawning

SIZE/AGE

Maturity: 10-20 cm FL

Longevity: Several years

Holacanthus bermudensis

Early Life History Description

EGGS

Diameter: 0.7 mm, transparent, spherical

No. of oil Globules: one

Yolk: Homogenous

Hatch Size: 2.5 mm NL

Incubation: 15 -20 hrs.

Pigment:

Diagnostic Characters:

LARVAE

Head Spination: Supraorbital, one or more small
simple spines on lateral ridge, subopercle,
interopercle, post-temporal, supracleithrum,
lacrimal, circumorbital, nasal, and dentary

Preal length:

Length at Flexion: 3.5mm SL

Sequence of Fin Development:

Pigmentation:

Diagnostic Characters: "D" fin shape

EARLY JUVENILES

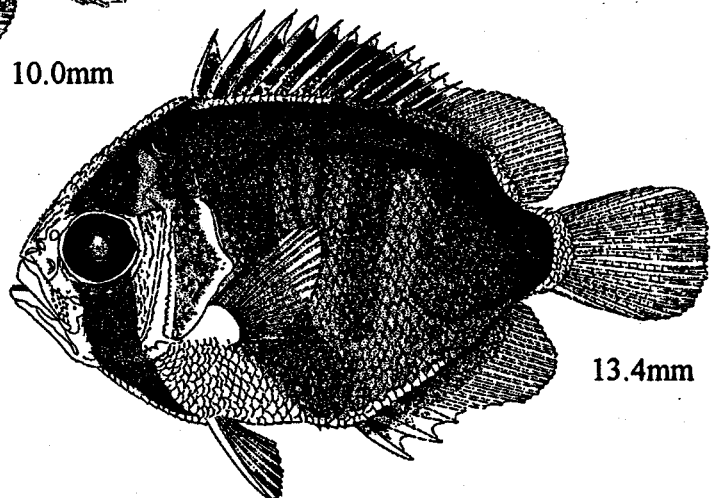
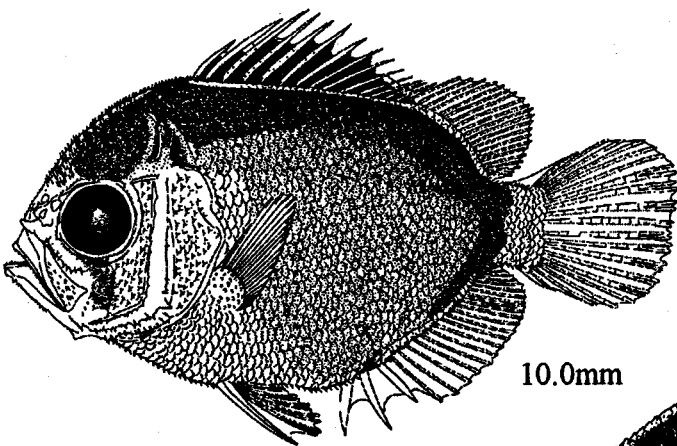
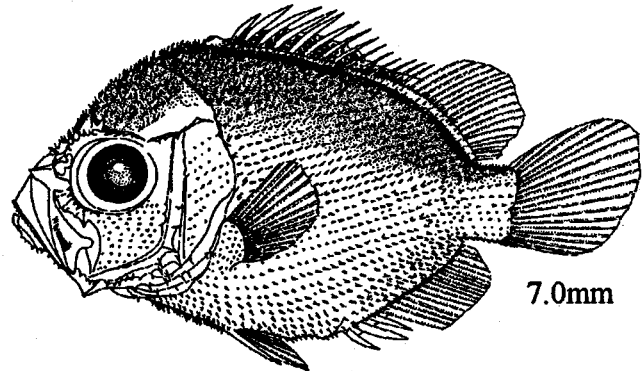
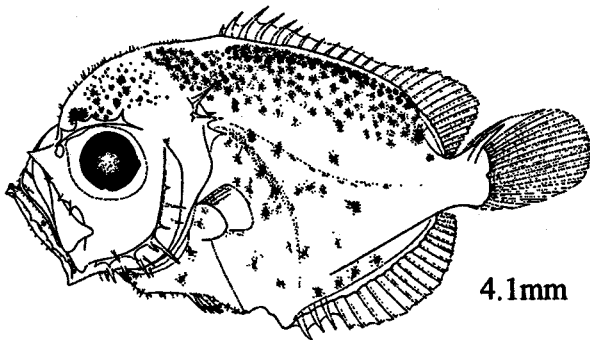
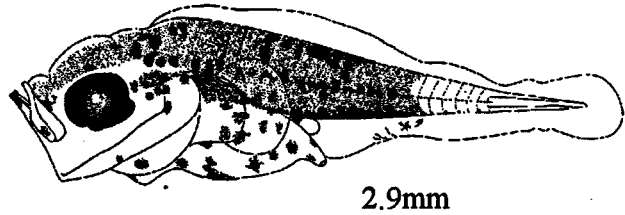
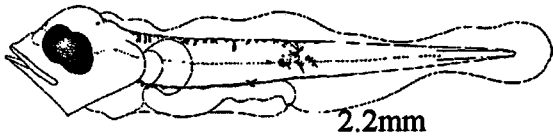
Settlement Size: 20mm SL

Pigment:

Diagnostic Characters: Second major bar on body
straight

LITERATURE: Feddern, 1968; Thresher, 1979;
Allen, 1980; Moyer, et al. 1983;

POMACANTHIDAE *Holacanthus bermudensis*



POMACANTHIDAE**Holacanthus ciliaris**

Meristic Characters**Early Life History Description****VERTEBRAE**

Precaudal: 10

Caudal: 14

Total: 24

First Dorsal Fin: XIV(XIII-XV)

Second Dorsal Fin: 21(19-21)

Anal Fin: III, 21(19-21)

Pectoral Fin: I, 18-19

Gill Rakers: 4 + 10 + 5 = 18-22

Predorsal bone formulae: 0/0/2/1+1

LIFE HISTORY

Range: From Fla. to Brazil, Bahamas & Gulf of Mexico

Habitat: Coral reefs, depths 1-70m

ELH Pattern: pelagic eggs & larvae; juveniles ectoparasite or mucophagy cleaners

SPAWNING

Season: None

Area: Coral reefs, 1-2m above ground

Mode: harems, 1 male, 2-4 females, sunset

Migration: None territory

Fecundity: 25 to 75 thousand eggs per spawning

Size/Age

Maturity: 25 cm FL

Longevity: up to 10 years

EGGS

Diameter: 0.70 mm, transparent, spherical

No. of oil Globules: one

Yolk: Homogenous

Hatch Size: 2.0 mm NL

Incubation: 15 -20 hrs.

Pigment: Pigment along dorsal, ventral edges of body, scattered pigment across lateral mid section

Diagnostic Characters: pigmentation

LARVAE

Head Spination:

Preanal Length:

Length at Flexion: 3.2-3.5 mm SL

Sequence of Fin Development:

EARLY JUVENILES

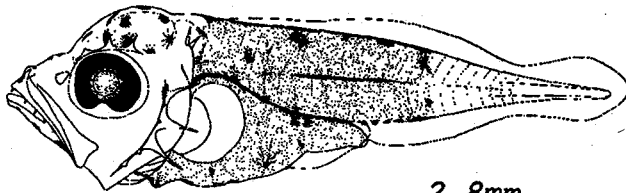
Settlement Size: 20 mm SL

Diagnostic Characters: neon blue circle on forehead, second major bar curved on body.

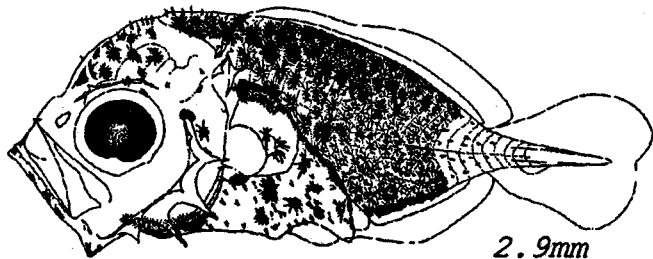
LITERATURE: Feddern, 1968; Moe, 1976; Thresher, 1979; Allen, 1980; Moyer, et al. 1983;

POMACANTHIDAE

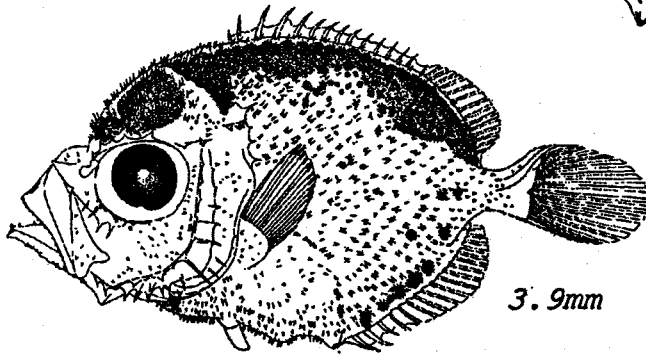
Holacanthus ciliaris



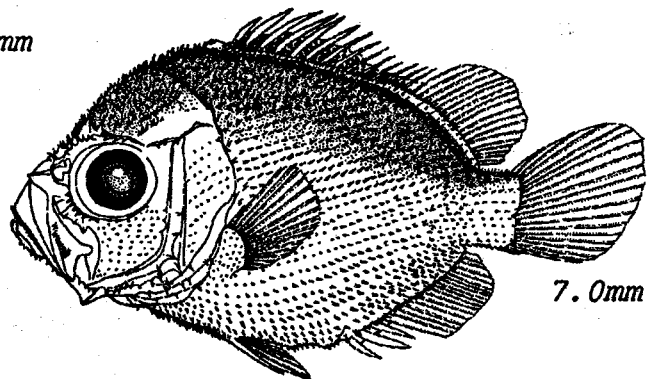
2.8mm



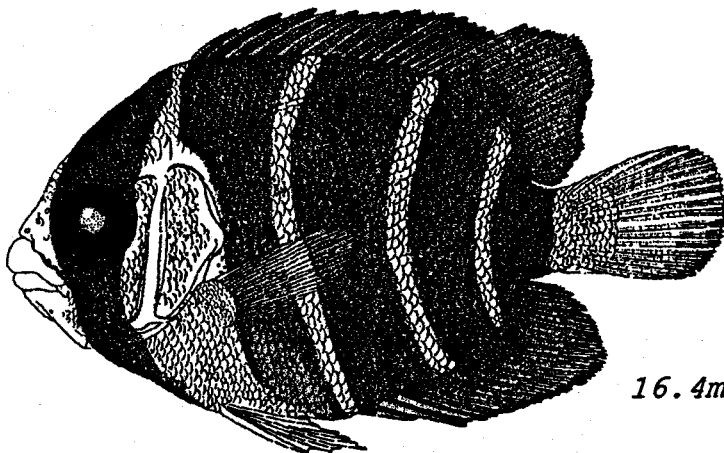
2.9mm



3.9mm



7.0mm



16.4mm

POMACANTHIDAE

Meristic Characters

VERTEBRAE

Precaudal: 10

Caudal: 14

Total: 24

First Dorsal Fin: XIV (XIII - XV)

Second Dorsal Fin: 19 (18-20)

Anal Fin: III, 20 (19-20)

Pectoral Fin: I, 17 (16-18)

Gill Rakers: 3 + 8 + 1 + 5 = 17 (14-18)

Predorsal bone formulae: 0//2/1+1

LIFE HISTORY

Range: Bermuda, N. & S. Caribbean Sea, Florida, Gulf of Mexico

Habitat: Coral reefs, depths 1-70 m

ELH Pattern: pelagic eggs & larvae; coral reefs usually on/around Montastrea larvae & juveniles ectoparasite or mucophagy cleaners

SPAWNING

Season: February through June

Area: Coral reefs, 1m above ground

Mode: Form Pairs

Fecundity: 25 to 75 thousand eggs per spawning

SIZE/AGE

Maturity: 7-9 cm TL

Longevity: Several years

Holocanthus tricolor

Early Life History Description

EGGS

Diameter: 0.65 to 0.75mm, transparent, spherical

No. of oil Globules: one

Yolk: Homogenous

Hatch Size: 1.95 mm NL

Incubation: 15 -20 hrs. after fertilization

Pigment:

Diagnostic Characters

LARVAE

Head Spination:

Preanal Length:

Length at Flexion: mm SL

Sequence of Fin Development:

Pigmentation: scattering of single melanophores along dorsal & ventral edges of lateral body, pigment on lateral line midbody. Dorsally heavy pigmentation medially from mouth to midbrain, and dorsal portion of gut. Pigment ventrally on lower jaw, isthmus, cleithra symphysis. No pigment on dorsal or anal fins.

Diagnostic Characters: pigment pattern, body shape, fin shape

EARLY JUVENILES

Settlement Size: 15 mm SL

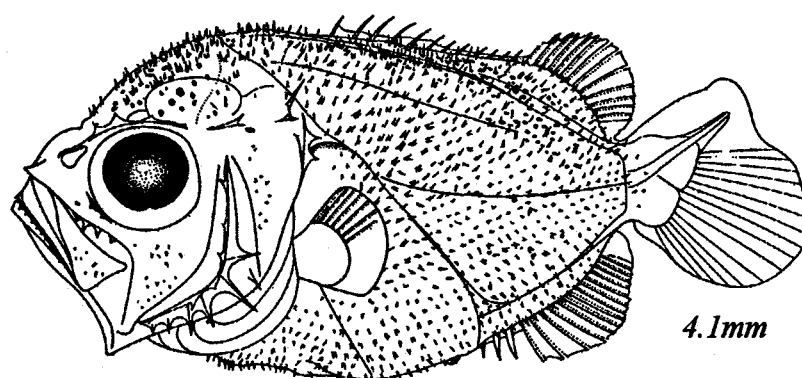
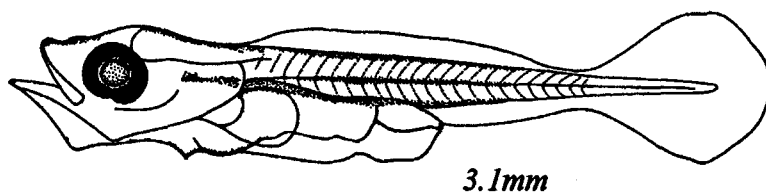
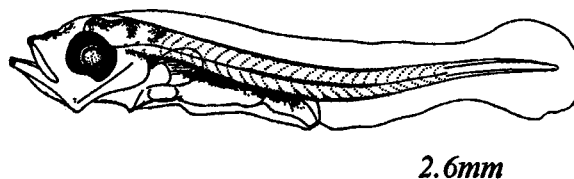
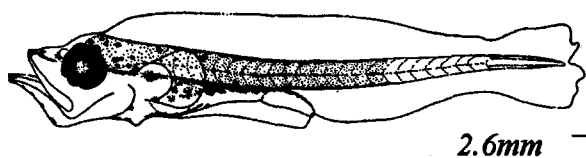
Pigment: Bright yellow with small black spot (encircled with blue) on upper anterior side of body.

Diagnostic Characters: scale spination, pigmentation, gillraker count lower than other Holocanthus.

LITERATURE: Bellomy, 1975; Thresher, 1979; Allen, 1980; Bauer and Bauer, 1981.

POMACANTHIDAE

Holacanthus tricolor



GENUS Pomacanthus

The genus Pomacanthus contains two species, P. arcuatus and P. paru. This genus can be separated with relative ease from the other two genera by pigmentation and meristic counts. Both species of Pomacanthus are heavily pigmented with melanophores uniformly covering the lateral body anteriorly from the anteriormost edge of the premaxilla to the caudal region. Darker stellate melanophores are scattered on this uniform pigment. Separation of the two species using pigmentation is not clear until between 8 to 10 mm SL, when juvenile pigment patterns develop. Meristic counts allow separation of the two species at approximately 5.0 mm SL when the first dorsal fin is completely developed. Fin counts for the first dorsal are nine spines for P. arcuatus and ten spines for P. paru. The second dorsal fin has an adult complement of rays at approximately 6.0 mm SL.

Common arrangement of predorsal bones, pterygiophores, fin spines and rays in relation to the skull and vertebral column for 34 *P. arcuatus* and six *P. paru* modified after Matsui (1967). A, skull and vertebrae numbers; B, interneural and interhaemal space numbers; C, number of pterygiophores in the respective interneural or interhaemal space; D, number of fin spines or rays associated with the pterygiophore; E, frequency of occurrence in 14 specimens for the pterygiophore number in the respective interneural or interhaemal spaces.

Pomacanthus arcuatus

PREDORSAL BONES		FIRST DORSAL FIN						SECOND DORSAL FIN																
30	30	27	31	31	31	31	31	31	31	29	20	19	26	18	21	21	17	14	8					
0	0	3	2	1	1	1	1	1	2	2	2	3	3	3	3	3	3	3	4					
1	1	1	2	1	1	1	1	1	2	2	2	3	3	3	3	3	3	3	3					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20					
8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
										11	12	13	14	15	16	17	18	19	20					
										1	2	2	3	3	2	3	3	4	1					
										3	2	2	3	3	2	3	3	4	2					
										34	33	17	23	17	18	11	13	10	10					
										ANAL FIN														

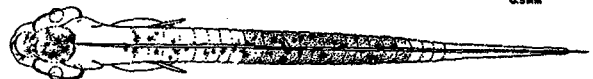
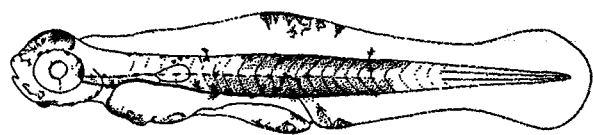
***P. paru*:**

PREDORSAL BONES		FIRST DORSAL FIN						SECOND DORSAL FIN																
6	6	6	6	6	6	6	6	6	6	6	3	4	6	5	3	5	5	6	4					
0	0	3	2	1	1	1	1	1	2	2	2	3	3	3	2	3	3	3	4					
1	1	1	2	1	1	1	1	1	2	2	2	3	3	3	2	3	3	3	3					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20					
8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
										11	12	13	14	15	16	17	18	19	20					
										1	2	2	3	3	2	3	2	3	3					
										3	2	2	3	3	2	3	2	3	4					
										6	6	4	4	4	3	5	4	3	5					
										ANAL FIN														

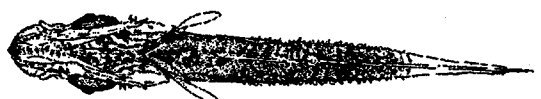
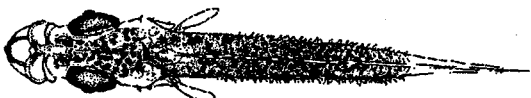
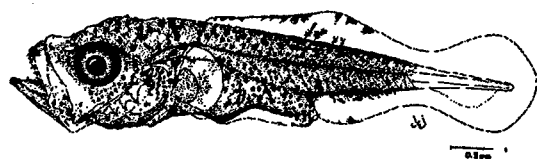
POMACANTHIDAE	<u>Pomacanthus arcuatus</u>
Meristic Characters	Early Life History Description
VERTEBRAE	EGGS
Precaudal: 10	Diameter: .9 mm, transparent, spherical
Caudal: 14	No. of oil Globules: one
Total: 24	Yolk: Homogenous
First Dorsal Fin: IX(VIII-X)	Hatch Size: 2.5 mm NL
Second Dorsal Fin: 33(30-33)	Incubation: 15-20 hrs. after fertilization
Anal Fin: III,22-24	Pigment:
Pectoral Fin: I,18-19	Diagnostic Characters:
Gill Rakers: 17-18(16-19)	LARVAE
Predorsal bone formulae: 0/0/2/1+1	Head Spination: Supraorbital, one or more small spines on lateral ridge, subopercle, interopercle, post-temporal, supracleithrum, lacrimal, circumorbital, nasal, and dentary
LIFE HISTORY	
Range: From New England to Caribbean, Gulf of Mexico and southern Brazil	Length at Flexion: 4.5-5.0 mm SL
ELH Pattern: Omnivorous; pelagic eggs & larvae adult diet mainly sponges	Sequence of Fin Development: Second dorsal & anal concurrently, first dorsal, pelvic & caudal, pectoral
Habitat: Adults, juveniles on coral reefs in depths 1-66m	Pigmentation: uniformly dark with single melanophore on top
	Diagnostic Characters: pigment pattern, body shape,
SPAWNING	
Season: April through September	EARLY JUVENILES
Area: Coral reefs, 1m above bottom	Settlement Size: 20 mm SL
Mode: Form pairs	Pigment: Uniform dark pigmentation with single melanophores on top, five nonpigmented bars across body
Migration: None	Diagnostic Characters: scale spination, pigment pattern, nine dorsal spine, caudal truncated
Fecundity: 25 to 75 thousand eggs per spawning	LITERATURE: Miller, G. L. and S. C. Jorgenson 1973; Moe, M. 1976,1977; Kelley, S.1995;
SIZE/AGE	
Maturity: 25 cm FL	
Longevity: 10 years	

POMACANTHIDAE

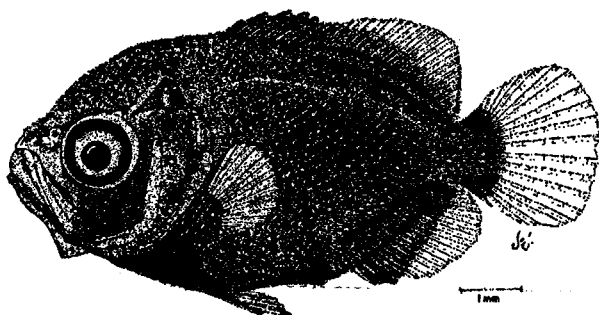
Pomacanthus arcuatus



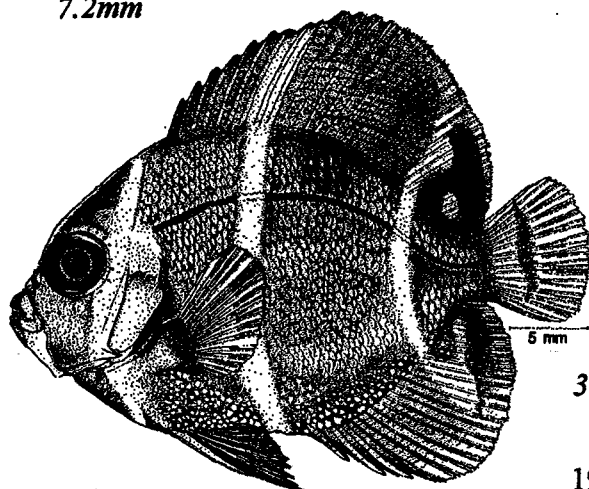
2.9mm



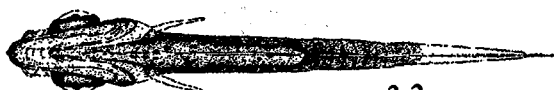
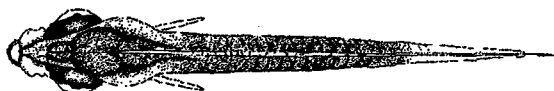
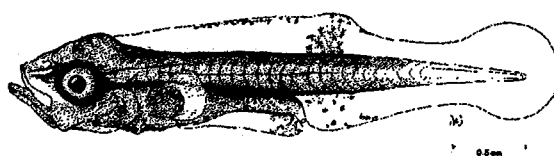
4.4mm



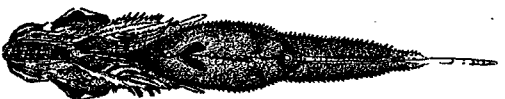
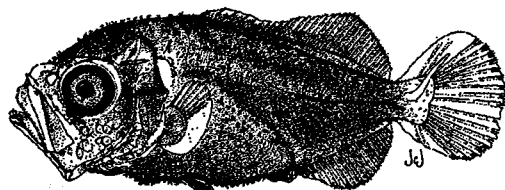
7.2mm



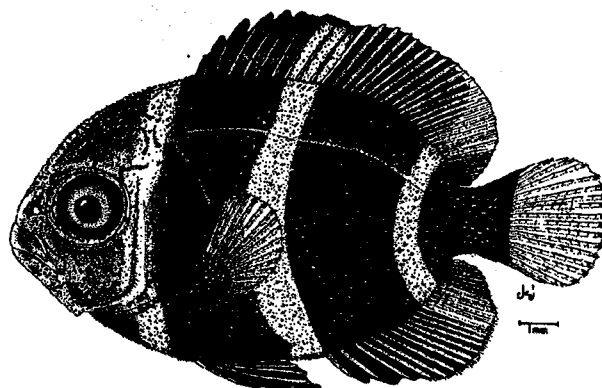
31.6mm



3.2mm



5.0mm



11.6mm

POMACANTHIDAE**Pomacanthus paru**

Meristic Characters**Early Life History Description****VERTEBRAE****EGGS**

Precaudal: 10

Diameter: 0.9 mm, transparent, spherical spiracle

Caudal: 14

No. of oil Globules: one

Total: 24

Yolk: Homogenous

First Dorsal Fin: X(IX-X)

Hatch Size: 2.5 mm NL

Second Dorsal Fin: 29-32

Incubation: 15 -20 hrs. after fertilization

Anal Fin: III,21-25

Pigment:

Pectoral Fin: I,18(17-20)

Diagnostic Characters:

Gill Rakers: 18(17-20)

LARVAE

Predorsal bone formulae:0/0/2/1+1

Head Spination: Supraorbital,one or more small simple spines on lateral ridge,subopercle, interopercle, post-temporal, supracleithrum, lacrimal, circumorbital, nasal, and dentary

LIFE HISTORY

Range: Western Atlantic from Bahamas and Florida thur the Caribbean to S.E. Brazil, Gulf of Mexico and introduced to Bermuda

Length at Flexion: 3.2-5.0 mm SL

Habitat: Coral reefs, depths 41-70 m

Sequence of Fin Development: Second dorsal & anal, first dorsal, pelvic & caudal, pectoral

ELH Pattern: pelagic eggs & larvae; shallow coral reefs, juveniles cleaners, adults paired or solitary

Pigmentation: uniform dark with single melanophores

Diagnostic Characters: pigment pattern, body shape, scale spination

SPAWNING**EARLY JUVENILES**

Season: April through September

Settlement Size: 15 mm SL

Area: Coral reefs, 1 m above bottom

Pigment: Uniform dark pigmentation with single melanophore on top, six none pigmented bars

Mode: Form pairs

Diagnostic Characters: Scale spination, pigment pattern, ten dorsal spines, caudal rounded,

Migration: None,

Fecundity: 25 to 75 thousand eggs per spawning

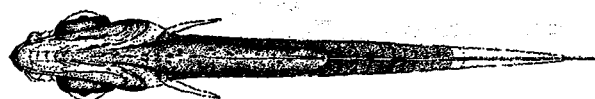
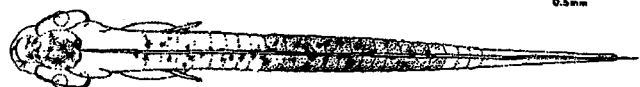
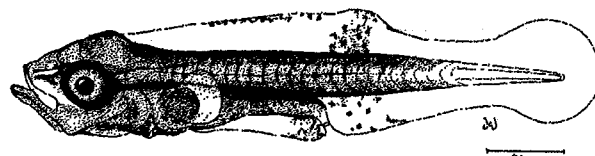
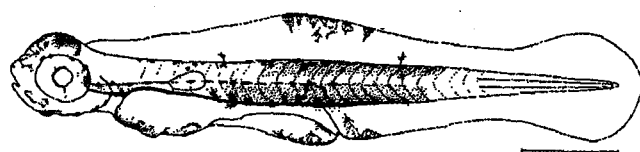
LITERATURE: Moe, M. 1976; Allen, G.R. 1980; Ferrern, 1972; Miller, G.L. and S.C. Jorgenson, 1973;**SIZE/AGE**

Maturity: 25 cm FL

Longevity: 10 years

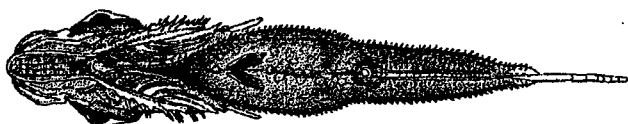
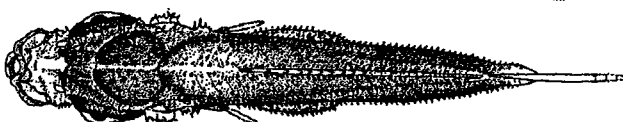
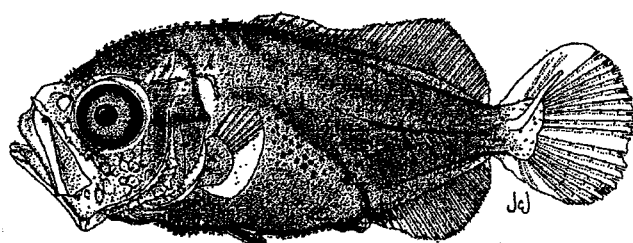
POMACANTHIDAE

Pomacanthus paru

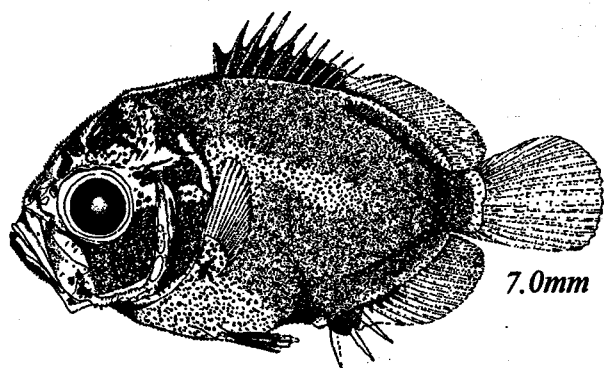


2.9mm

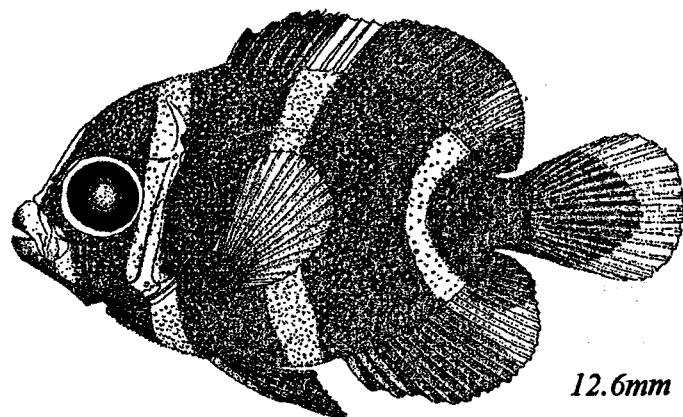
4.4mm



5.0mm



7.0mm



12.6mm

Table 1: Identification characters between the three genera of Pomacanthidae

Genus	<u>CENTROPYGE</u>	<u>HOLACANTHUS</u>	<u>POMACANTHUS</u>
Predorsal bone form.	0//2/1+1	0//2/1+1	0/0/2/1+1
First dorsal fin	XIV, 3rd spine elongated	XIV	IX & X
Second dorsal fin	16-18	18-21	29-33
Anal fin	III,16-18	III,18-21	III,21-25
Gill Raker count	21-24	17-20	17-18
Flexion	3.3-3.8mm	3.2-3.5mm	4.5-5.0mm

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